Soil and Nutrient Network

Helping farmers improve soil and nutrient management

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Case study -
Newmills of Boyne, Banffshire

Newmills of Boyne, farmed by Mr James Beattie and his family, is a predominantly arable farm extending to 405 hectares situated to the west of the town of Banff in the north east of Scotland. The farm is made up of three separate but nearby units – Tillynaught, Muirake and Newmills of Boyne itself. The majority of the land farmed is tenanted with a small proportion owned. A range of arable crops are grown on the farm, with the main crop being spring barley for the malting market. 2018 also saw shopping swedes and carrots being grown, potatoes, swedes for stock feed, green manures as part of an environmental scheme plus both temporary and permanent grass. Winter wheat and spring oats are also sometimes included in the rotation to ensure that the business complies with the three crop rule.

In addition to the arable operation, the business also maintains a herd of 40 spring calving suckler cows which utilise the areas of the farm that cannot be ploughed. All the progeny from this herd are finished on the farm. There is also a large pig finishing enterprise on the farm which is a valuable source of farm yard manure for the business.

The land farmed by the business is mainly classed as grade 3(2) under the Land Capability for Agriculture Classification System. There are also small areas of better quality grade 3(1) land and also some pockets classed as grade 4(2). This type of land should be capable of producing good yields of cereals and grass. The soils are all of either the Tarves or Strichen soil association and are described mostly as non-calcareous gleys. The vast majority of the soils found on the farm are classed as either imperfectly drained or poorly drained.

Know your soils

The focus of the first meeting at Newmills of Boyne was the importance of knowing your soils and understanding soil structure.

Soil structure assesses the size, shape and hardness of the particles and lumps that make up the soil. Poor soil structure can lead to various problems such as reduced drainage; decreased yields and quality of crop due to reduced plant growth and inefficient uptake of applied nutrients.

A Visual Evaluation of Soil Structure (VESS) assesses the soil structure based on the appearance and feel of a block of soil dug out with a spade. Soil structure is the scored on a scale of Sq1 (good)- Sq5 (poor).

Good soil structure has rounded aggregates that crumble readily when moist and has abundant pores running throughout to allow good flow of water drainage and root growth.

Poor soil structure is usually very compacted with large, hard and sharp blocks. It isn't very porous and tends to crack horizontally. Root presence is low and the soil can often smell 'rotten' and take on a blue/ grey colour. Find out more in the Valuing Your Soils booklet available at www.fas.scot

For more information on the Soil and Nutrient Network see www.fas.scot For dates of SNN events, find us on Facebook or follow us on Twitter @FASScot

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SAC Consulting
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The European Agricultural Fund for Rural Development
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Soil Analysis - The Key to Maximising Yields

The importance of lime was the topic of one of the meetings held on the farm. Newmills of Boyne carries out quite regular soil analysis. Some recent results from the farm are shown in Table 1 below.

Table 1

Field	Crop	pH	P	K	Mg	S	Cu	Mn	B
Cistern Top	Sp barley	5.8	M (-)	M (+)	M	H	M	M	M
Cistern Btm	Sp barley	5.7	M (-)	H	M	H	M	M	M
Roadside Top	Sp barley	5.8	M (-)	M (+)	M	H	M	M	M
Roadside Btm	Sp barley	6.1	M (-)	M (+)	H	H	M	M	M
Drakemyre	Fallow	6.0	M (+)	M (-)					
Brackens	Sp barley	5.9	L	M (-)					

The Drakemyre and Brackens fields were not tested for trace elements. The results for pH are quite mixed, with most samples slightly below the recommended pH range for arable crops and temporary grass in the area of approximately 6.0 – 6.2. It became clear in the discussion of the soil results that it is extremely important for farmers to know which laboratory has analysed their soil samples and what method of analysis has been used. There is a difference in how samples are tested between English and Scottish laboratories, and the recommended requirements that are provided with sample results can vary accordingly.

We have a set of Technical Notes that provide targeted regional information for Phosphorus and Potassium recommendations. Regional differences in soil extractable P concentrations exist primarily in response to differences in land use and particularly the greater role of livestock in the west compared to arable cropping in the east. No obvious or consistent temporal trend in extractable P is apparent, but a very wide range of soil properties and extractable P on concentrations is evident. You can download the documents from the Nutrient Planning section of our website at https://www.fas.scot/crops-soils/soils/

Lime is absolutely essential for many reasons. Below a pH of approximately 5.6, aluminium becomes far more available and will cause aluminium toxicity, inhibiting root growth and yield in many plants. Different crops have a different danger level for pH, below which their growth will be affected to some degree e.g. lime deficiency will begin to be seen below a pH of 5.9 in barley, 5.3 in oats, 5.0 in potatoes, 5.6 in white clover etc. With the main crop on Newmills of Boyne being malting barley, maintenance applications of lime will be beneficial in many fields to keep the pH above 5.9.

Find out more about liming materials and recommendations in Technical Note TN714 available from our website.


TECHNICAL NOTE TN714 April 2019 • ELEC

Liming materials and recommendations

SRDP Farm Advisory Service

Summary

- Maintaining optimum acidity status is required to achieve maximum yields. When soils are below target for pH yields will be lower and this should be accounted for as part of your fertiliser management plan.
- Regular soil analysis with accompanying field information is essential to manage lime inputs for optimum yields and profitability.
- There has been a large drop in the number of soil pH samples from 69,062 (1993-1997) to half this during the last 5 years.
- Recent studies have shown that pH levels are declining on grassland farms.
- Liming recommendations for different soils and cropping systems are tabulated.

Introduction

SAC

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Key Fact

At a pH of 5.5, it has been shown that only 77% of the nitrogen, 48% of the phosphate and 77% of the potash present will be available to the plant. Raising the pH to 6.0 increases these levels to 89% for nitrogen, 52% for phosphate and 100% for potash.

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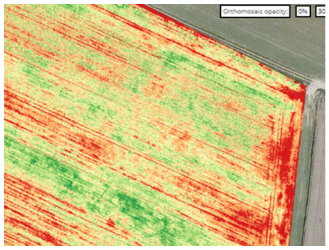
Soil Structure at Newmills of Boyne

The summer of 2017 was extremely wet in the north east of Scotland and created numerous difficulties on the poorly and imperfectly drained soils of Newmills of Boyne. A considerable level of damage had been done to soils over the harvest period of 2017, whether this be fields that had grown grain, potatoes or carrots. Mr Beattie was therefore very keen to look at the effects on the soil structure of harvesting these crops when soil conditions had been extremely wet. A number of soil pits were dug over two different fields on the farm in the summer of 2018. These fields had also been photographed in spring of 2018 prior to being sown into a crop of spring barley, and then mapped during the growing season using normalised digital video imagery to help locate where potential problems might be.

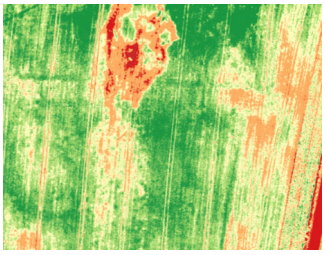
The areas showing as red in the NDVI image are areas of the field where there is less green leaf. A number of problem areas were very quickly identified and test pits dug to see if any issues could be identified.

Field 1. Aerial photo of field after carrot harvest



Field 1. NDVI image of SB following carrots

Field 2. Arable field showing growth of rushes



Field 2. NDVI image of SB following cultivation

Field 1. Soil pit

Field 1 shown above had grown a crop of carrots in the 2016 growing season which was not harvested until the summer of 2017. This was an extremely wet summer in the north east of Scotland and the process of harvesting the carrots and carting them off the field in large trailers left extremely deep wheel tracks. The straw which had been used to insulate the crop from frost over winter was then incorporated using a large, heavy cultivator, again when the soil was quite wet. The overall effect of this can be seen in the aerial photograph above with deep tracks throughout the field full of water. Despite this, the field was sown into a crop of spring barley in the spring of 2018. This was a very thin crop. The soil pit from field 1showed a number of different issues. The incorporation of the straw with a deep cultivator had resulted in there not really being any structure to the soil at all. The cultivations had been carried out to such a depth that there was subsoil within the topsoil and vice versa. Straw was also mixed in with the soil to a depth of more than 30cm. Below this layer was a hard compacted zone in the upper subsoil. This compacted layer was impeding drainage, leading to a perched water table. While not much could be done to immediately rectify the soil structure in the short term, drainage of the site could be improved by having a working drainage system with a good depth of gravel backfill. This would have allowed the field to be subsoiled (In the correct conditions) allowing the trapped water to flow through the profile to reach the drains below.

Field 2 Soil pit

Field 2 shown above did not have the soil structure issues that field 1 had, but had a compacted layer at the base of the topsoil. The most likely cause of this compaction was farm machinery. The rooting depth was found to be quite limited and in many parts of the field, drainage was an issue with water not able to drain through the compacted layer. Assuming a good drainage system is in place in the field, subsoiling to a relatively shallow level will break up the compacted layer and allow water to drain away. Fields without a working drainage system would benefit from this being installed in order to get the benefits from subsoiling this compacted layer.

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Field drainage

Our final event theme of field drainage followed on from discussions during the previous meeting. Very kindly, our host James Beattie, allowed us to dig some deep holes in some of his fields to learn in the field about drainage problems and how these might be fixed. Soils & drainage expert Gavin Elrick was our main speaker during the event, and with his breadth of experience and knowledge was able to lead what was a great interactive event.

Field drainage is fundamental to farming, both crop production and livestock production. There has been little focus on this topic in recent years and, given the recent wet weather experienced in the area and the difficulty in harvesting crops, establishing winter cereals etc., there is an increasing interest in how an effective drainage system can improve production. Many of the current drainage systems in place on Scottish farms were installed over 20 years ago and without maintenance are now starting to fail. When surface water indicates a problem or a VESS in the field shows signs of drainage problems more often than not, a bit of time and investment will offer a return with improved crop performance and yields, but this can take many years to balance out. It is important to take the health of the soil into consideration – as has been seen locally, the weather conditions are changing and fields that have ineffective drainage systems are more likely to incur damage from heavy machinery use, particularly if the soil structure is compromised by a failing drainage system.

The main focus for this event was in a field with some obvious signs of surface water. Gavin discussed the importance of outfall, accurate measurement of depth, gradients, the size of drainage pipe required, the different types of drainage pipes, pipe spacing and crucially the importance of stone/gravel in any drainage system. Whilst stone can be a high cost in any drainage system, it's inclusion helps to prevent drainage system failure due to clogged pipes and compaction around the drains which will prevent water from reaching the system; Gavin explained some of the ways that the quantity of stone can be reduced within a drainage system and how the soil type that is being drained can have an impact on the type of system installed.

During the event, there was an discussion around estimating a cost to the installation of a completely new drainage system for the field in question, whilst also calculating what increase in crop yield would be required to pay for these works. However, it is important to remember that fields that are waterlogged will not only have reduced production capacity but become a potential diffuse pollution risk if fertilisers are applied – there is an increased risk of runoff, and plants may be unable to utilise all of the nutrients if the root systems are compromised. Beyond the environmental problems this can incur, there is a financial loss to the farmer when applied nutrients are ineffective.

Find out more in our online technical notes:

- Technical Note (TN720): Assessment for land drainage;
- Technical Note (TN728): Planning agricultural field drainage